

Serial No.: 10/036,877  
Amdt. Dated: September 30, 2004  
Reply to Office action of July 27, 2004.

RD-29276-1

### REMARKS

In the Office Action dated July 27, 2004 the Examiner again rejected claims 1-26. In a telephone interview with the Examiner on August 30, the Examiner, Applicant James M. Silva, and the Applicant's representative (Andrew J. Caruso) discussed the case and although no agreement was reached, it was decided that for purposes of greater clarity, claims reciting step (c) as a "polishing step" should be amended to recite treatment of the brine with a "carbonaceous adsorbent". Claims 1, 5, 14, 18, and 19 have been so amended. Additionally, the Examiner suggested helpfully that additional data allowing side by side comparison of "Methods 1-3" and demonstrating the surprising superiority of Methods 2 and 3 relative to Method 1 would help to demonstrate the non-obviousness of the claimed invention. Such data are presented in the attached declaration from Applicant Silva.

### 35 USC § 103 (a) Rejections

The Examiner has again rejected claims 1-26 under 35 USC 103 (a) as being unpatentable over Silva et al. (US 6,426,008) or WO 01/14252 in view of Silva et al. (US 6,214,235). The Examiner has again further rejected Claims 1-4 and 7-13 under 35 USC §103 (a) as being unpatentable over Silva et al. (US 6,426,008) or WO 01/14252 in view of Vaughn et al. (US 4,747,957). The Applicants courteously traverse these rejections.

The Examiner states that (quote) :

- o "Each of the primary references discloses purifying brine for use in a membrane electrolyzer (see col. 1, line 10 of Silva et al.; and page 1, lines 5-6 of WO 01/14252) by subjecting this brine to the recited pH adjustments and functionalized resin treatments at the recited conditions. (se col. 13, line 12 through col. 14, line 32 of Silva et al. ; and page 23 , line 3 through page 24, line 28 of WO 01/14252)."

The Examiner further states that (quote):

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- o "Accordingly each of these primary references discloses the claimed invention with the exception of the recited polishing treatment. The secondary reference discloses that brines of the type recited (see col. 3, lines 9-10) must be treated with adsorbents of the type recited (see col. 2, lines 19-20 and 23) if these brines are to be used in membrane electrolyzers (see col. 1, lines 18-26 and 31-24)."

The Examiner goes on to state that it would have been obvious to one of ordinary skill in the art at the time the invention was made to substitute the brine of the secondary reference for the brine of either primary reference, since this secondary reference is capable of functioning, after the appropriate adsorbent treatment, in a membrane electrolyzer in substantially the same manner as the brine of either primary reference, to product substantially the same results.

The Examiner further states that (quote) :

- o "Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to subject this brine to the purification treatment of either primary reference and then to the additional treatment of the secondary reference (i.e polishing), in order to allow this brine to be used in the membrane electrolyzers of either primary reference (see col. 1 line 10 of Silva et al.; and page 1, lines 5-6 of WO 01/14252."

In contrast to earlier methods of brine purification, the Applicants have discovered that the sequence of the purification steps is key to successful brine purification. Thus the Applicants' broadest claim (currently amended claim 1) recites:

A method for removing impurities from a brine solution, the method comprising the steps of:

- (a) adjusting the pH of the brine solution to a pH of from about 2 to about 4 and passing the brine solution through a first functionalized resin; said first functionalized resin having functional groups capable of removing transition metal cations from the brine solution;

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- (b) adjusting the pH of the brine solution to a pH of from about 9 to about 11.5 and passing the brine solution through a second functionalized resin, said second functionalized resin having functional groups capable of removing alkaline earth metal cations from the brine solution; and
- (c) treating the brine solution with a carbonaceous adsorbent following step b).

The Applicants' claimed invention clearly requires that the "polishing step" (step (c)) follow step (b). There is no suggestion in the prior art that the order of the brine purification steps (a)- (c) is critical to the successful purification of the brine. The data (reproduced below for convenience) provided in the DECLARATION OF APPLICANT UNDER 37 CFR §1.132 attached hereto, clearly shows the surprising criticality of the order of the brine purification steps in reducing voltage penalties in subsequent electrolysis of the brine. Moreover, the Applicant's declaration reveals as unnecessarily restrictive the original limitation requiring that the brine being purified comprise a "water soluble chelating agent". Claim 1 has been amended to encompass the purification of any brine solution using the brine purification methods (Methods 1 and 2) of the instant invention.

TABLE 1\* (from DECALRATION)

Example	Brine	ppm Sodium Gluconate	Treatment	Voltage increase Rate
1	Ultrapure	0	Method 1	4 mV/hr
1	Ultrapure	0	Method 2	1 mV/hr
1	Recycle	0	Method 3	0.05 mV/day

The brine employed in the "Example 1-Method 3" contained no sodium gluconate and had the same "brine strength" (i.e. concentration of sodium chloride in grams per liter) as the ultrapure brine used in "Example 1-Method 1" and "Example 1-Method 2". The brine employed in the "Example 1-Method 3" did, however, contain higher levels of

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certain impurities associated with reduction in electrolysis cell lifetime and increased voltage penalties. Thus, results obtained in Example 1-Method 3 are especially compelling in light of the very low voltage penalty observed relative to the comparative example, Example 1-Method 1. The Applicants thus respectfully assert that, contrary to the Examiner's statement it would not have been obvious to one of ordinary skill in the art at the time the invention was made to subject this brine to the purification treatment in sequence such that the "polishing step" (step (c)) was required to follow step (b). No combination of the primary Silva reference and the secondary Silva reference can be fairly construed to disclose or suggest the Applicants' claimed invention. The Applicants respectfully submit that there is no motivation to combine primary Silva reference and secondary Silva reference, in any particular order to provide a purified brine for use in a membrane electrolyzer.

The Applicants' data (Table 1\*, from Declaration) show clearly that surprisingly, much more effective control of the "voltage rate increase" is achieved when a brine purification method of the Applicants' claimed invention (Methods 2 and 3) are employed. Each of Methods 2 and 3 require that step (c), the "polishing" step, follow step (b).

Because no combination of the references cited discloses or suggests the Applicant's claimed invention, the Examiner has failed to make a prima facie case of obviousness required to sustain rejection under 35 U.S.C. 103(a). For this reason the Applicants respectfully request that the rejection of claims 1-26 under 35 U.S.C. 103(a) as being unpatentable over Silva et al. (US 6,426,008) or WO 01/14252 in view of Silva et al. (US 6,214,235) be withdrawn.

The Examiner has rejected claims 1-4 and 7-13 under 35 U.S.C. 103(a) as being unpatentable over Silva et al. (US 6,426,008) or WO 01/14252 in view of Vaughn et al. (US 4,747,975). The Examiner states (quote):

- o "Each of the primary references discloses the claimed invention with the exception of the recited polishing treatment. Vaughn et al. discloses a similar process for purifying brine to be used in a chloralkali cell (co. 6, line 34), and

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teaches subjecting this brine to a polishing treatment after conventional treatment after a conventional[ly] ion exchange resin treatment, in order to catch any hardness values that escape through the ion exchanger (col. 6, lines 25-30)."

The Examiner goes on to state that accordingly, it would have been obvious to one of ordinary skill in the art at the time the invention was made to subject the treated brine of either primary reference to the polishing treatment of Vaughn et al., in order to obtain the advantages of this secondary reference for the process of either primary reference.

The Applicants respectfully assert, that the process taught in Vaughn et al. teaches the use of ethylene/acrylic acid copolymers (EAA) fibres in a "polishing step" to prevent "break-through" of ionic species responsible for brine "hardness" after the ion exchange resin becomes fully saturated with such ions. The Applicants respectfully submit that a careful reading of Vaughn et al. shows that the "polishing" step disclosed in Vaughn et al. does not constitute a polishing step within the meaning employed by the Applicants in the instant invention. The polishing step disclosed in Vaughn et al. is carried out to remove "hard" ions,  $\text{Ca}^{++}$  and  $\text{Mg}^{++}$ , referred to in Vaughn as "hardness values", and the adsorbent employed by Vaughn et al. is an ion exchange resin, not a "carbonaceous adsorbent" as employed in the instant invention. As the Applicants' disclosure makes clear (See paragraphs 54-56) the carbonaceous adsorbents employed in the polishing step of the instant invention are designed to remove impurities introduced by the ion exchange resins used in steps (a) and (b) of the instant invention. These impurities are not "breakthrough" of brine contaminants ( $\text{Ca}^{++}$  and  $\text{Mg}^{++}$ ) but are thought to be small organic molecules which are leached from the ion exchange resins used in steps (a) and (b). Further, those skilled in the art will understand that the carbonaceous adsorbents used in the polishing step of the instant invention are chemically different from the ethylene-acrylic acid copolymer fibres (EAA fibres) used in the "polishing step" disclosed by the Vaughn reference. The carbonaceous adsorbents used in the method of the instant invention have very limited ability to bind cations such as  $\text{Ca}^{++}$  and  $\text{Mg}^{++}$ . As the Vaughn reference makes clear in Example 1 (column 4, lines 57-68 and column 5, lines 1-7) the EAA fibres are a type of ion exchange resin which exchanges sodium ions

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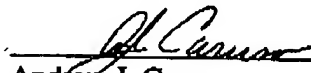
for calcium and magnesium ions present in the brine. Moreover, the EAA fibres and owe their binding ability to the relatively high concentration of carboxyl groups present in the ethylene/acrylic acid copolymer. Thus, the "polishing" step disclosed in the Vaughn reference is carried out using a different type of resin and is carried out for a different purpose than the "polishing" step of the instant invention. The Applicants also disclose that the polishing step of the instant invention may help remove quaternary ammonium salts (QS) present in the brine undergoing purification.

The Applicants respectfully submit that no combination of Silva et al. (US 6,426,008) or WO 01/14252 with Vaughn et al. (US 4,747,975) either discloses or suggests the Applicants' claimed invention. In view of these remarks, it is respectfully requested that the rejection of claims 1-4 and 7-13 under 35 USC § 103 (a) as being unpatentable over Silva '008 or WO 01/14252 in view Vaughn be withdrawn.

In view of the foregoing, the Applicants respectfully submit the application is now in condition for allowance. Favorable reconsideration and prompt allowance of the claims are respectfully requested.

Should the examiner believe that anything further is needed to place the application in even better condition for allowance, the Examiner is requested to contact the Applicants' undersigned representative at the telephone number below.

Respectfully submitted,

  
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